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SURFACE PREPARATION AND COATINGS
DESIGN/PRODUCTION INTEGRATION
HUMAN RESOURCE INNOVATION
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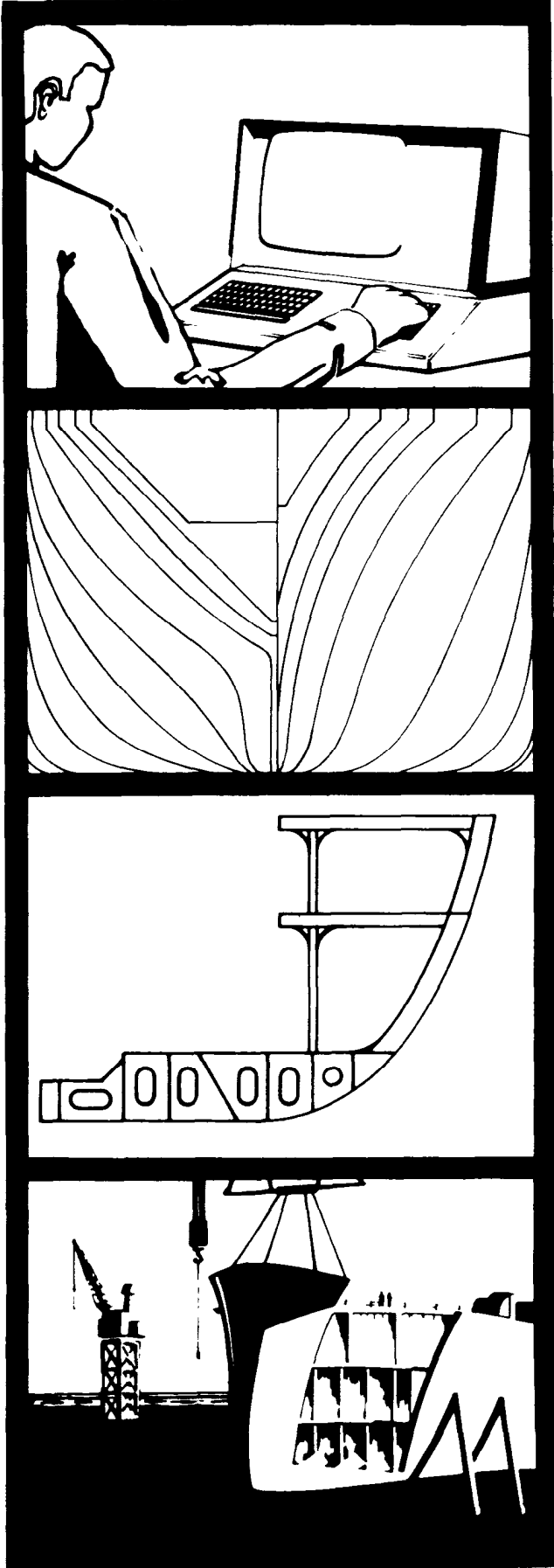
Paper No. 21: Development of Effective Computer Capabilities by the J.J. Henry Company

U.S. DEPARTMENT OF THE NAVY
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SHIPBUILDING

**Proceedings of the
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**DEVELOPMENT OF EFFECTIVE COMPUTER CAPABILITIES
BY THE J. J. HENRY COMPANY**

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Mr. Fritz has been a long-time participant in the computer field having been employed in computer-related functions with the U.S. Government, Westinghouse Electric, and Sun Ship Inc before joining J. J. Henry Company in May 1980 where he heads the engineering computer operations at their Morsetown Division.

Mr. Fritz holds degrees in mathematics from Loyola College and Johns Hopkins University.

ABSTRACT

On April 2, 1980, the J. J. Henry Company, Inc signed an agreement with Cali & Associates to use the SPADES system of computer programs to enhance its preliminary contract and detail design service for its clients. As a design agent for the shipbuilding industry, J. J. Henry has been making use of computers for many years; however, this latest step involves a major extension of its production services to computer-aided design.

The paper briefly discusses the new SPADES service, the facilities installed, the training required, and the problems in getting the new service into full production on a very tight schedule. Also included is a listing of the application programs available via its terminal facilities using a variety of off-site computer network services.

Introduction

J. J. Henry Co., Inc. has been making use of the digital computer as an important tool in support of its services to the nation's shipbuilding industry for a number of years. However, in May of this year it took a major step toward the growth of that computer usage by formally establishing an Engineering Computer Operations Department and directing the new Department Head as follows:

- 1) assist all other Departments in implementing more effective computer-aided design techniques,
- 2) coordinate, expand and improve our overall computer capabilities, and
- 3) assist our production services function in achieving the benefits of the SPADES computer programs as a major tool in our design and production services.

This paper covers briefly what has transpired during the nearly 6 months that have elapsed since the new Department was created.

It should be noted at the outset that although J. J. Henry has offices at a number of locations throughout the country, this new commitment to computer-aided design is at its major production office in Morestown, N. J., here in the Philadelphia metropolitan area. At Morestown, J. J. Henry produces a complete range of design and engineering services to marine and industrial firms. As of this writing, the Morestown office employs a staff of 226 individuals not including the headquarters financial staff which, although housed at Morestown, reports directly to the VP for Finance in New York City.

Other smaller J. J. Henry offices are located in Arlington, VA, Portsmouth, VA, Cohasset, MA, and Houston, TX. Area representatives are stationed in Cleveland, OH, and Los Angeles, CA. The company is headquartered at Two World Trade Center in New York City.

J. J. Henry has in the past used interactive, 300-baud terminals as the major means for accessing computer programs at several off-site network computer services; however, to provide the new on-line interactive computer service using SPADES, it has been necessary to expand our computer and data communications facilities by a significant factor.

The balance of this paper covers the nature of the SPADES system as used by J. J. Henry at this time, the new facilities that have been installed, the training completed to date, some of the problems resolved in the start up, and at the close of the paper, a brief listing of a number of computer application programs in use.

SPADES

The key to the new emphasis on computer-aided design is the Ship Production And Design Engineering System known as SPADES. On April 2, 1980, J. J. Henry signed an agreement with Cali & Associates acquiring the right to use major portions of the computer-based SPADES system. J. J. Henry personnel have been instructed on how to enter data into the system beginning with the use of the major computer program designated HULLOAD. HULLOAD enables our personnel to generate computer-oriented descriptions of hull structures and related design data. These descriptions are stored in the Ship File within the host computer and provide ship design data for later use in the Detail Engineering Module (known as DEMO). The DEMO module is being used at present to generate background drawings for a new detail design effort on the LSD-41, as well as to define structural details such as holes, stiffeners and butts. (The LSD-41 is to be constructed by the Lockheed Shipyard in Seattle, Washington.) The use of DEMO also provides a check on the content of the developing ship data base by making drawings of details as they are loaded into the computer. DEMO makes use of a

major portion of the SPADES' PART-GEN program to develop the flat plate parts needed in the construction of the hull of a ship. In addition to HULLOAD and DEMO, SPADES as used by J. J. Henry also includes major modules for FAIRING and HULL calculations. To date, HULLCAL is being used, but the LSD-41 hull itself was FAIRed by Cali personnel.

As most of you already know, the software for the SPADES computer system as developed by Cali & Associates is maintained on a PRIME 750 digital computer at their location in Metairie, LA. J. J. Henry personnel now make use of that system via terminal equipment recently installed in the new computer room located at our Morestown office. The data to be entered into the system is prepared on the SPADES System Input Data Form. Data from these forms is copied into the computer data base - the Ship File - using any one of the four on-line terminals.

The major advantage to a design agent in using a data-base-oriented, computer-aided design system such as SPADES is the resulting capability to gradually develop in a machine-processible format a continually more complete and accurate representation of the ship design as it advances through the design and production stages of a contract. With relatively simple but powerful commands, portions of that file can be accessed and drawings automatically plotted as required at any stage of the process.

But that is enough for now on SPADES itself. The system has been under development for many years and has been widely reported by REAPS. Suffice it to say that J. J. Henry selected the SPADES system and the computer service approach developed by Cali as a major tool to enhance its capability to satisfy the ship design and production needs of its clients. Fil Cali will discuss the computer-sharing concept by designers and shipbuilders in the next paper on today's program

Facilities

At last year's REAPS Technical Symposium, Bill Shipley of Marinette Marine and Fil Cali discussed the hardware required to provide N/C processing for a small shipyard. Much of that same kind of equipment is now in use at J. J. Henry except that since we are not a shipyard, we do not need the equipment required for a plate burning center or a plate shop office.

The J. J. Henry computer facilities for engineering are housed in a single room, 19' x 24', with large glass viewing windows on two sides. To cut down on equipment noise, the floor of the room is covered with static-resistant, wall-to-wall carpet and the walls and ceiling with acoustic tile. A separate air conditioning temperature control is available, but no humidity control is provided nor is there any indication of a need for such a control.

The computer room is used both as a computer operations center and as a computer-user training room. The equipment used to access the off-site computer includes 6 computer terminals plus associated data communications hardware as shown on Figure 1.

The terminal equipment assigned to the use of SPADES includes a high-speed, upright, drum-belted Calcomp 960 plotter with a 909 controller (containing a microprocessor and two floppy disk storage devices), two DEC LA 120 printer terminals and a DEC VT 132 alphanumeric video terminal. A dedicated 9600 baud data communications line, multiplexor, and modem connects this equipment to the host computer.

The baud rates used for communication to the host computer are limited by the 9600 baud Bell System line, the capability of the multiplexor, the capacity of the host computer and the characteristics of each terminal. With respect to

TERMINALS

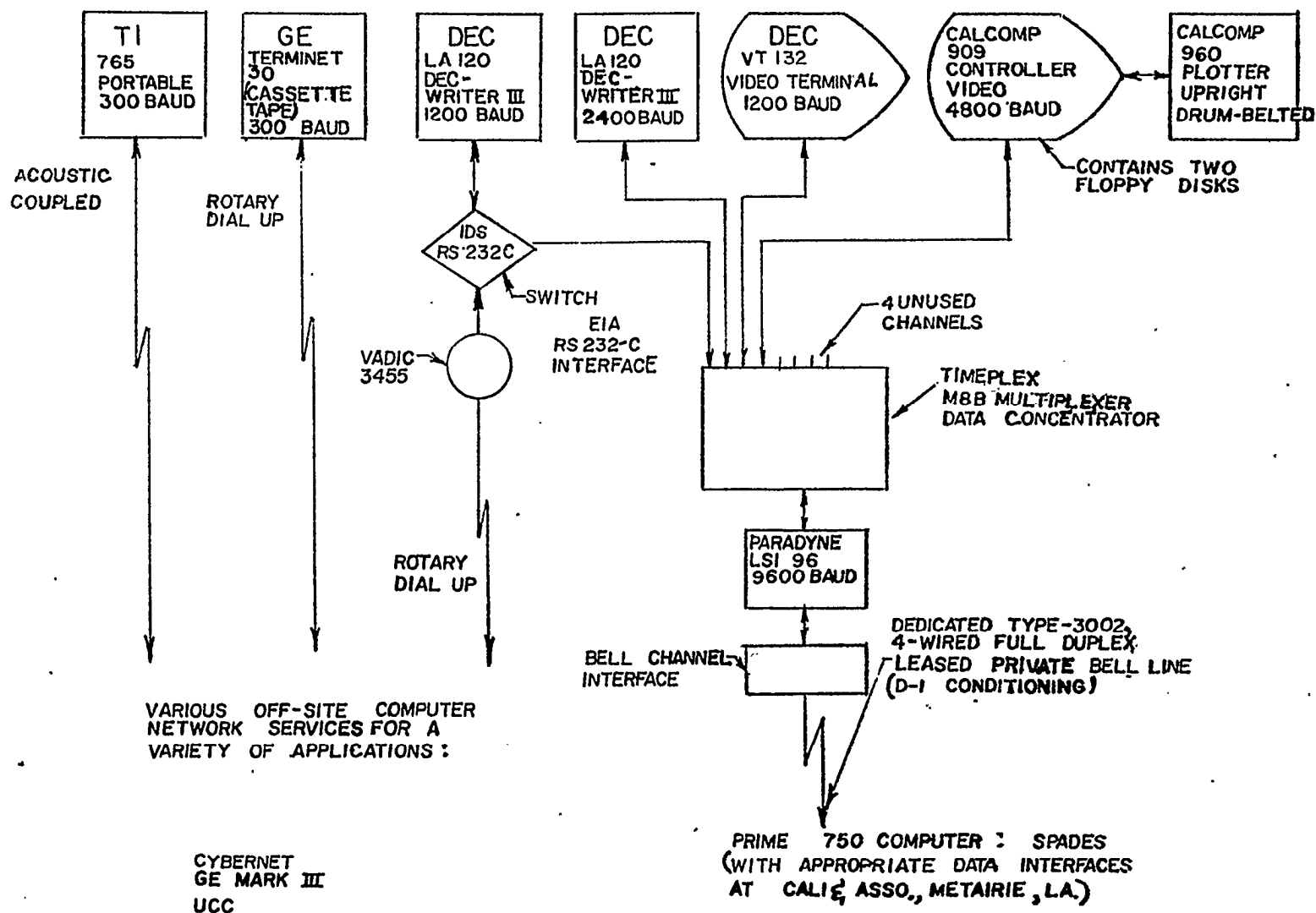


FIGURE 1: ENGINEERING COMPUTER FACILITIES-J.J. HENRY-MOORESTOWN, NJ

the communications network, the Timeplex Model MBB is an 8-channel unit in which channels 1 through 4 are each capable of operating at speeds up to 4800 BPS and channels 5 through 8 are each capable of operating at speeds up to 9600 BPS. The aggregate input limit is 57,600 BPS (i.e., $4 \times 4800 + 4 \times 9600$). The baud rates selected for each terminal represent a compromise among what make sense for that terminal's capabilities, system performance requirements including human response times, and the overall system performance desired by Cali and the PRIME computer used to service his clients. Current performance speed as noted is satisfactory for the present level of production.

As noted in Figure 1, there is a portable TI 765 slow speed terminal with bubble memory that can be used to access any of the dial-up network services in current use. The GE Terminet 30 shown has been in use for several years. The Terminet, like the TI 765, operates at 300 baud. It contains a tape cassette memory as a local memory. To provide faster printout from the dial-up network services, one of the DECwriters has been equipped with a switch and a 1200 baud Vadic modem, thus providing an alternate use for that one DECwriter as well as increased line print capability for the dial-up services. All terminals except the GE Terminet were installed during June or July of this year.

It should be emphasized that the operation is completely terminal- and data-base oriented. In fact, the system is entirely free of punched cards and the resulting problem of a variety of program decks located in various desks throughout the office. Another feature is the absence of a high speed line-at-a-time printer. Our fastest printing device is the 2400 baud DECwriter III. As an example of the limitation, this unit takes about 40 minutes to print 132 pages of a ship's complete hydrostatic data. However, with three other printers and two viewing screens, this print speed limitation has not proven to be a problem

The Calcomp plotter is a very high quality drafting machine capable of producing complete drawings either directly from the on-line data base or alternately from the pair of floppy disks. The plot data, in fact, can be transmitted from the PRIME 750 to the floppy disks and thence to the plotter in one step. The drawing size is limited to 33" x 60". Conventional drafting paper or mylar can be used with either pressurized ball point, liquid ball point or liquid ink (needed for plotting on mylar). Again the capability of the equipment satisfies existing needs and appears to be an effective, low cost, 1980 state-of-the-art operational facility.

In addition to these facilities at Moorestown, J. J. Henry also has computer terminals at most of its other locations. A network of IBM word processing computers, for example, is used to support that phase of the operations. An IBM System 3 for Management Systems, Accounting and Payroll functions is also in use. In addition, at least four programmable electronic calculators (two with attached printers) are in use at the Moorestown office with others in use at our other offices.

Training,

As you may well appreciate, a major aspect of getting a coordinated, expanded and improved computer capability into being has been the requirement for an increased level of computer-related training for a relatively large number of our employees. Unfortunately (or should I say fortunately), J. J. Henry has been extremely busy with project work and it has been difficult to schedule the number of individuals desired for the training programs that have been conducted. As a result, at this point in time we do not have the number of individuals fully trained, especially in the use of SPADES, that we would like. However, as a result of some excellent top level instruction given by key Cali personnel to a

relatively few J. J. Henry personnel , it is expected that we do have an adequate nucleus of trained personnel who will be able to share their knowledge with others as the production work load grows. Since last May, some 113 man-days have been invested in computer-oriented training, involving some 18 different J. J. Henry employees. All training has been conducted in Morestown.

In order that the training be as useful as possible, it has been planned in a workshop format. As was mentioned earlier, our 19' x 24' computer room was designed as a combination computer operations and training area where the individual would receive not only classroom instruction, but also hands-on experience using terminals to access the individual host computer. For the GE Mark III and UCC Dynaflex training, additional portable acoustic coupled terminals were employed to make possible parallel use of the computer by those receiving instruction.

As was mentioned earlier in describing the computer room, sound absorbing tiles were installed on the walls. See Figure 2. This construction proved useful in training classes since training aids, drawings and computer plots and other computer printout could easily be mounted on the walls for general viewing. Along one end of the room, (at the head of the class) two 4' x 8' chalk boards were installed. One of these boards is embossed with the SPADES System Input Data Form for use by both the instructor and student. Shelves, supply cabinets, and work tables in the room provide easy access to required reference material, computer input forms , and other needed supplies. The terminals are installed along the outside walls since we do not have a raised computer floor. A plug-in phone, with a long extension cord, is available at the terminal for voice communication with off-site technical support personnel. This has been especially

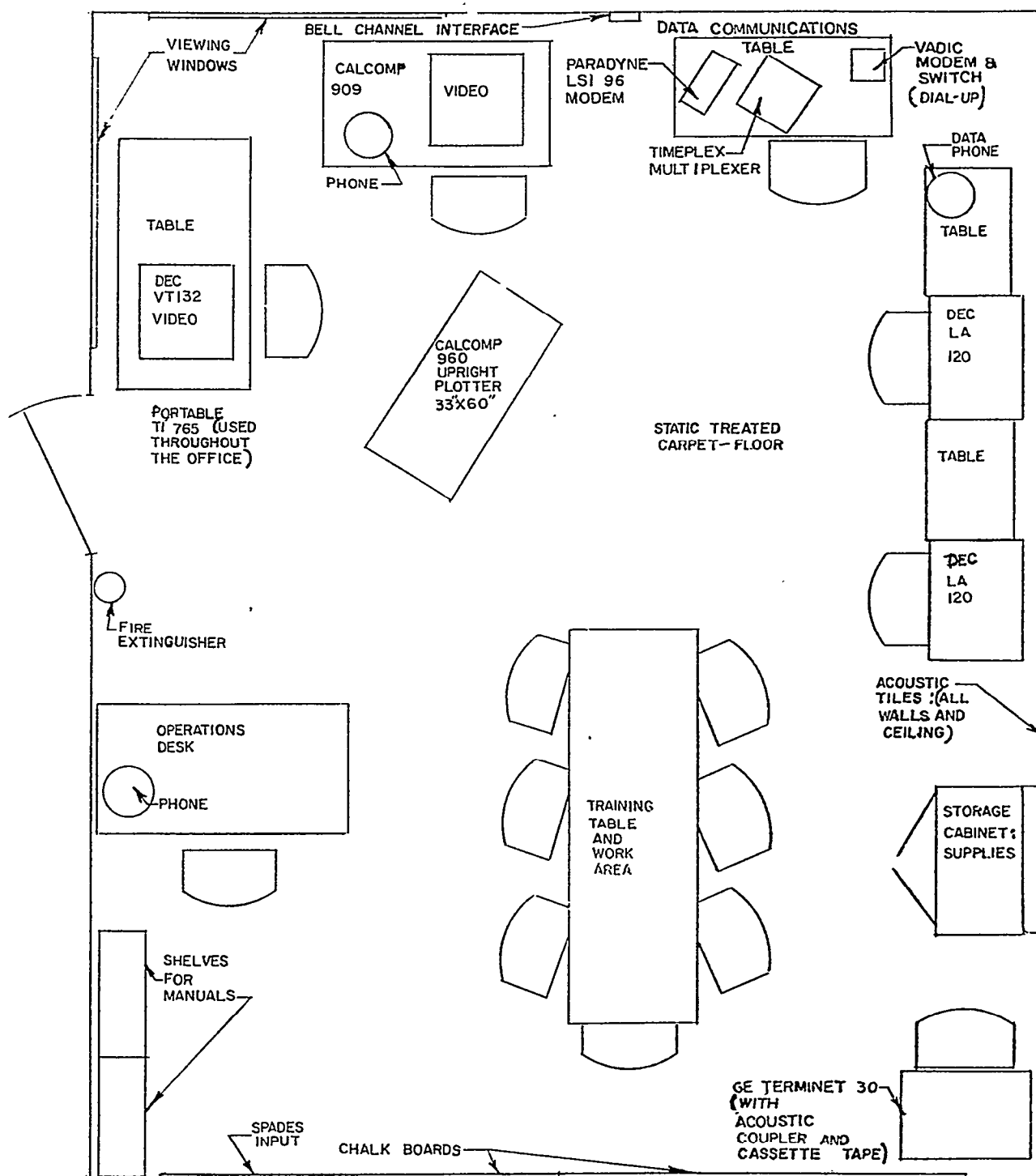


FIGURE 2, COMPUTER OPERATIONS CENTER AND
COMPUTER - USER TRAINING ROOM - J. J. HENRY- MOORESTOWN, NJ.

helpful for the new user who is able while operating a terminal to communicate (using our WATS line) with service center support personnel whether the facility being used is in Metairie, LA, Rockville, MD, or elsewhere. In fact, such conversations with other Cali users, especially Stuart Whitman, formerly of NASSCO, were a big initial help to us in getting the Calcomp and DRAW portion of our SPADES service into effective operation. This audience doesn't need to be reminded that the Computer Network Service business is very competitive and a decision to select GE or Cybernet or whoever is often determined by the quality and helpfulness of the individual technical support staff at the local office supporting the installation. This is especially true in an "open shop" environment where the individual engineer and technician directly use the network service.

Other facets of the training that should be mentioned are program documentation and operating procedures for using the various systems. Again the successful network service vendors do a good job in providing training programs and user documentation. With respect to SPADES, it has been necessary for J. J. Henry to create a good deal of the needed operational documentation and "how to" material. By applying a Highlighting Marker to such data as entered into the computer via the DECwriter, the resulting "record" has proven to be of value as a guide for training others. An advantage of the DECwriter use over the VT 132 is the availability of such audit trails. Organizing such "data" for effective future use is of value for training follow-up.

Training is an on-going process, a process that doesn't end with a successful start-up. A continuing investment of time and money is projected to continue in order to enhance our growing capabilities.

Problems

Any steps toward increased automation or computer-aided design will be unsuccessful unless there is initial and continued top management commitment and, may I add, "patience." The decision to carry out the computer usage expansion described was a top level decision by J. J. Henry Co. management, especially John Klose, Director, Hull Design; Dave McMullen, Assistant VP; Andy Brown, Senior VP, Moorestown Division; and Charlie Zeien, President. This decision was widely disseminated and understood throughout the Company. The commitment having been made, plans and schedules were developed and adequate funds allocated. The required equipment was placed on order and personnel from Cali & Associates made their time available to provide the necessary training. In general, the move to enhanced computer capabilities has gone quite well. However, a few problems have been encountered and our experience in resolving these problems may be of value to others.

With respect to the added terminal and communication equipment, the major problem has been in dealing with the multitude of vendors involved, i.e., Calcomp, DEC (Transnet), Paradyne and Timeplex (Noakes), TI (Westwood), Vadic (GE) and N. J. Bell. Each vendor met his delivery schedule with only minor slippages measured in days. By dealing with Noakes Data Communications for both the 9600 baud modem and the multiplexor, we were able to gain the experience of Cali's tie-in to five other off-site locations and install the particular communications equipment that was proving satisfactory in their current operation. With respect to this equipment, Noakes personnel were used for both installation and on-going maintenance, recognizing, however, that since the Noakes personnel are located in Irving, TX, trouble-shooting and on-site testing and repair must be carried out by J. J. Henry local staff taking advantage of advice and support from Noakes personnel via the WATS line.

As noted in the equipment section, only 4 of the 8 channels are in use and even those are not used to the maximum baud rates available, thus providing a service cushion. The maintenance of an effective data communication system is particularly sensitive to the multiple vendor problem. Since we have the most to lose, we have learned to recognize problem symptoms and take the responsibility in getting the problem resolved by dealing with Cali, N. J. Bell, and/or Noakes. Problems in this area which have occurred include the following: open circuit in Bell System at one of the junction points in our dedicated line, a defective board in our Timeplex multiplexor, and an incorrectly programmed microprocessor board in the multiplexor unit at Cali's office in Metairie. The data communications system itself has been designed to be nearly fail-safe with a variety of built-in automatic checks, and except for some very occasional data interrupts in the middle of on-line plots and some "lost data" on all terminals, the communications network has performed well to date.

The Calcomp 909 controller has had a fair amount of down time, totalling about 4 days over the period starting July 21. Service support is provided by the Calcomp personnel stationed in the Philadelphia metropolitan area and has been satisfactory. Usually the service response to a reported malfunction of the controller is within 24 hours, often within a few hours. The delay has not usually caused a serious problem since in the beginning the malfunction is usually intermittent rather than a hard "no-go." The 960 plotter itself seems to be extremely rugged - in fact, except for some minor pen-skipping problems, there have been no difficulties with the plotter. The pen and vellum plots have been extremely good. Ink on mylar (required for some Navy contracts) is now satisfactory after some experimentation with different inks and pen sizes. The ink on mylar drawings are best when done from the "floppy" rather than on-line.

The procedure adopted is to make the drawing with pen on paper while copying the plot control instructions on to the floppy. After checking to see that the drawings are good, the floppies are scheduled for a succession of ink on mylar drawings in the local mode. The manuals provided by Calcomp are barely adequate and, in general, it has been necessary to adapt the material and re-document it for our operational environment. An operational procedure manual is maintained in the computer room and is updated as new, more effective ways of doing things are developed by our staff or others. We have been a SPADES user for only the past 3 months, but last March one of our staff attended their User Group Meeting. These meetings are held on an annual basis and provide an effective vehicle whereby the half dozen or so organizations using SPADES are able to effectively communicate with the individuals developing and maintaining the SPADES system. A major objective of these meetings seems to be the obtaining and prioritizing of user requests for system enhancements. From my long experience in the computer field, I know of no effective major service that does not have an active users' group. Such groups, in general, serve as an excellent means for training follow-up, getting user input for prospective system enhancements, and communicating planned changes.

In the training section, I indicated that it was difficult to free up personnel for required training. This was particularly difficult this past summer as a result of the heavy work load and the usual summer vacation schedule. Hopefully, our nucleus of trained personnel will continue to share this knowledge and experience with others who were not a part of the initial classes. The problem of converting the accumulated knowledge in using computer systems effectively into adequate, easily available, HOW TO documentation is a problem that will gradually be solved by continued attention. In using several other

computer network services besides the Cali SPADES system, J. J. Henry personnel are also confronted with the problem of doing things a little differently depending on which network they are using. Most such computer systems provide useful prompting; however, switching back and forth does require user adaptation and leads to some loss in efficiency. It should also be added that training without effective follow-up use is a wasted effort. On several occasions, individuals have been trained and then not had an opportunity to use what they have learned.

A final problem point is the heavy computer load frequently experienced in mid-morning and mid-afternoon on most computer networks. In particular, we are concerned over the success of Cali's computer network and the resulting heavy usage and the occasional resulting lack of capability of the network to provide an acceptable response time. The usual wait is often about an hour, but at times the wait for a production run can be much longer. Cali has recently simplified the procedure whereby his users can change the priority of the run they are submitting. Such changes require acceptance of a higher charge and since each user can see the listing of jobs in the queue, as well as each other's priority, there is danger that a priority escalation will increase Cali's income without actually improving individual service. In general, however, I must add that the PRIME 750 system has an excellent operating system with good response time, has a powerful editor and, in general, is a most acceptable price performance system in the 1980 marketplace.

Application

Before concluding, I believe it is desirable to at least list some of the broad range of application programs that we at J. J. Henry have found useful in effectively serving our clients. The major recent thrust, of course, has

been the various modules of the SPADES system, but from the following list it should be clear that SPADES is only one facet of our computer-aided design service. Included in the following list are some of the programs used by the NYC office primarily on the UCC Computer Network. The programs listed include a number of proprietary programs (including the SPADES modules, as well as a number of other programs that are only available on particular computer networks). Another group of programs were obtained from the U. S. Navy, i.e., the well-publicized CASDAC programs. Suffice it to say that we, as an organization, attempt to stay up to date with the continually more powerful and more effective computer programs available in our industry and to adapt those programs which are appropriate to satisfy most efficiently our client requirements.

Among these programs are the following:

1. GENERAL NAVAL ARCHITECTURAL
SPADES: HULLCAL
SHIP HULL CHARACTERISTICS PROGRAM (SHCP)
HYDROSTATIC TABLE PREPARATION
DAMAGED STABILITY REPORTS.
2. LINES GENERATION AND ALTERATION
SPADES: FAIRING
MODIFICATION OF "PARENT" HULL LINES
GENERATING LINES BASED ON SERIES 60
3. SHIP HULL DESIGN AND DRAFTING
SPADES: HULLLOAD
SPADES: DRAWING
SPADES: DEMO
SPADES: PART GEN
4. PIPE STRESS ANALYSIS
DYNAFLEX
TRIFLEX
5. SHIP MOTIONS
SCORES
SHIP MOTION AND SEA LOAD
DYNAMIC TANK PRESSURE

6. SPEED/POWER ESTIMATION
SERIES 60 STANDARD SERIES
TAYLOR STANDARD SERIES
FULL-BODIED HULL FORMS
7. PROPELLER DESIGN
WAGENINGEN B-SCREW STANDARD SERIES
PROPELLER PARAMETER CALCULATIONS
8. STRUCTURAL ANALYSIS AND DESIGN
ANSYS
NASTRAN
BEAM/FRAME STATIC AND DYNAMIC ANALYSIS
MIDSHIP SECTION DESIGN AND COST ESTIMATION
HULL GIRDER DEFLECTIONS
HULL GIRDER SECTION PROPERTIES
9. SHIP ECONOMICS
LNG/LPG AND BULK CARRIER ECONOMICS
CONTAINERSHIP, RO/RO AND COMBINATION SHIP ECONOMICS

Conclusion

These remarks are an attempt to provide a status report on the use of computer-aided design at the J. J. Henry Co., Inc. as of October 1980. A solid foundation has been laid toward an effective computer-aided design service for our clients; however, a great deal more needs to be accomplished, especially insofar as integrating SPADES into our overall design services. For the future I expect to see a much increased volume of design and production services. On-line computer-based interactive graphics design is certainly a major next step as we continue to provide more cost effective design services for our industry in the years ahead.

Thank you.

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